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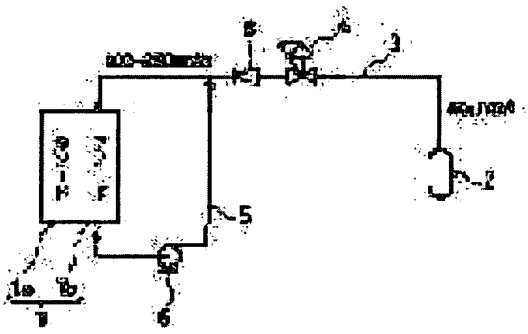
(71)Applicant : SANYO ELECTRIC CO LTD
(72)Inventor : TAJIMA OSAMU
MAKIHARA KATSUYUKI
MUKAI HIROSHI
ITO HIROYUKI
NAKATO KUNIHIRO
NISHIZAWA NOBUYOSHI

(54) FUEL CELL SYSTEM

(57)Abstract:
PURPOSE: To provide a fuel cell system effectively utilizing the unreacted hydrogen discharged to the outside as the combustion exhaust gas at a low cost.
CONSTITUTION: A fuel cell system is provided with a fuel cell main body 1 generating power with pure hydrogen used as fuel, a pure hydrogen storage means 2 storing the pure hydrogen fed to the fuel cell main body 1, and recycling means 5, 6 recycling the unreacted pure hydrogen not contributing to the cell reaction of the fuel cell main body 1 to the fuel cell main body 1.



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[Claim(s)]

[Claim 1] The fuel cell system characterized by having the fuel cell main part which generates electricity by using pure hydrogen as fuel, a pure hydrogen storage means to store the pure hydrogen supplied to the aforementioned fuel cell main part, and a recycling means to recycle the unreacted pure hydrogen which did not contribute to the cell reaction in the aforementioned fuel cell main part on the aforementioned fuel cell main part.

[Claim 2] The aforementioned pure hydrogen storage means is a fuel cell system according to claim 1 characterized by being the bomb filled up with the hydrogen storing metal alloy.

[Detailed Description of the Invention]

[0001]

[Industrial Application] this invention relates to improvement of the art of the unreacted hydrogen discharged by the cell reaction in detail in the case about the fuel cell system which used pure hydrogen as fuel.

[0002]

[Description of the Prior Art] A fuel cell is equipment made to generate electrical energy from the hydrogen which reforms fuel, such as natural gas, a methanol, naphtha, and coal, and is obtained, and the oxygen in air, and can obtain a high generating efficiency. Therefore, it is observed as a promising new power generation system which can be used for various uses from large-scale power generation to small-scale power generation from the object for space to the object for automobiles.

[0003] Instead of especially using reformed gas, such as natural gas, as fuel in recent years, the system which used pure hydrogen as fuel is proposed, and only a part with a high hydrogen partial pressure has the advantage that a generating efficiency is also high, compared with reformed gas. Pure hydrogen is filled up with such a system into the hydrogen bomb etc., and is generating electricity by supplying pure hydrogen to an anode from this hydrogen bomb in it.

[0004]

[Problem(s) to be Solved by the Invention] However, since the utilization factor of the pure hydrogen in the case of a cell reaction is generally about 90 - 95%, about 5 - 10% of pure hydrogen is discharged as unreacted hydrogen. Since the catalyzed-combustion machine for carrying out a

catalyzed combustion and equipment with a special exhaust gas burner etc. were needed separately although discharged out of the system after carrying out combustion processing with a catalyzed-combustion vessel, the system enlarged the unreacted hydrogen conventionally produced in the case of a cell reaction, and it had the technical problem that cost also became high. Moreover, since the pure hydrogen in a bomb cannot be used for a cell reaction 100%, it also has the technical problem that generating duration becomes short.

[0005] this invention is made in view of the above-mentioned technical problem, and while aiming at a deployment of the unreacted hydrogen discharged out of the system as a combustion gas, it aims at offering a low cost fuel cell system.

[0006]

[Means for Solving the Problem] this invention is characterized by the following things in order to solve the above-mentioned technical problem.

** It is characterized by having the fuel cell main part which generates electricity by using pure hydrogen as fuel, a pure hydrogen storage means to store the pure hydrogen supplied to the aforementioned fuel cell main part, and a recycling means to recycle the unreacted pure hydrogen which did not contribute to the cell reaction in the aforementioned fuel cell main part on the aforementioned fuel cell main part.

** The aforementioned pure hydrogen storage means is characterized by being the bomb filled up with the hydrogen storing metal alloy.

[0007]

[Function] If it has the recycling means like the above-mentioned composition, since the unreacted pure hydrogen (usually about 5 - 10%) which did not contribute to a cell reaction is recyclable on a fuel cell main part, the pure hydrogen supplied from a pure hydrogen supply means can be used for 100% electrode reaction of abbreviation. In this case, if a pure hydrogen supply means is the bomb filled up with a hydrogen storing metal alloy like the above-mentioned **, since the generating duration of a bomb will extend about 5 to 10%, the troublesome work of bomb exchange etc. can be reduced.

[0008] Moreover, since there is almost no unreacted hydrogen which can use pure hydrogen for 100% cell reaction of abbreviation, and is discharged out of a system, a catalyzed-combustion machine etc. becomes unnecessary. Therefore, enlargement of a system can be suppressed and reduction of cost can also be aimed at.

[0009]

[Example]

(The first example)

[Example 1] The fuel cell main part 1 which drawing 1 is the outline block diagram of the output 250W class fuel cell system concerning the first example of this invention, and generates electricity with pure hydrogen and the oxygen in air, The MH bomb 2 which stores the pure hydrogen supplied to this fuel cell main part 1, and the pure hydrogen charging line 3 which

supplies the pure hydrogen in this MH bomb 2 to the fuel cell main part 1, The regulator 4 which controls the flow rate of the pure hydrogen within this piping 3 etc., and the unreacted hydrogen recycling pipe 5 which recycles the unreacted pure hydrogen discharged from the fuel cell main part 1 on the fuel cell main part 1 through the pure hydrogen charging line 3, It mainly consists of blowers 6 which pressurize and (>200mmAq) pass unreacted hydrogen so that the unreacted hydrogen in this unreacted hydrogen recycling pipe 5 may return to the pure hydrogen charging line 3. Moreover, it is the pure hydrogen charging line 3, and the check valve 8 for antisuckbacks is formed in the piping 3 of a downstream rather than the regulator 4.

[0010] The aforementioned fuel cell main part 1 is the composition that the output 250W class phosphoric acid fuel cell was used, and cathode 1a and anode 1b have been arranged through a phosphoric-acid electrolyte (not shown). It fills up with the hydrogen storing metal alloy (for example, MmNi4.32Mn0.18aluminum0.1 Fe0.1 Co0.3) to which occlusion of about 400l. hydrogen was carried out in the aforementioned MH bomb 2. In addition, of course, it is also possible to use the hydrogen bomb of marketing filled up with pure hydrogen etc. instead of using the MH bomb 2.

[0011] Next, the operation of the constituted fuel cell system is concretely explained like the above. First, if air (oxygen) is supplied to cathode 1a of the fuel cell main part 1 while opening a regulator 4 and supplying pure hydrogen to anode 1b of the fuel cell main part 1 through the hydrogen charging line 3 from the inside of the MH bomb 2, a cell reaction will be started soon.

[0012] After a while, advance of a cell reaction produces the unreacted pure hydrogen (usually about 5 - 10%) which did not contribute to a cell reaction from the fuel cell main part 1. Pressurization (>200mmAq) supply of this unreacted pure hydrogen is carried out by the blower 6 in the unreacted hydrogen recycling pipe 5 to the pure hydrogen charging-line 3 side. Then, unreacted pure hydrogen (a pressure 100 - 200mmAq) is recycled at the anode 1b side, and is again used for a cell reaction. In this case, the pressures of the pure hydrogen supplied from the MH bomb 2 are 4 kg/cm2. It is a grade and is controlled by the downstream of a regulator 4 to be set to 100 - 200mmAq. Thus, according to this invention, the unreacted hydrogen which was not used at all can be effectively used only by discharging out of a system conventionally.

[0013] Thus, the constituted fuel cell system is called the (A) system below.

[Example 1 of comparison] As shown in drawing 3 , the unreacted pure hydrogen discharged from the fuel cell main part 11 was considered as the composition which discharges out of a system, after carrying out combustion processing by the catalyzed-combustion supply 30 through the unreacted hydrogen exhaust pipe 52 rather than recycling on the fuel cell main part 11, and also the same fuel cell system as the example 1 of the first example of the above and abbreviation was produced. In addition, in drawing 3 , 40 is a catalyzed-combustion machine, 30 is an exhaust gas burner for supplying combustion gas to a catalyzed-combustion machine, and 21 is MH bomb filled up with the hydrogen storing metal alloy.

[0014] Thus, the constituted fuel cell system is called the (X) system below.

[Experiment 1] The generating duration at the time of performing rated (250W) operation was investigated using the (A) system of the above-mentioned this invention, and the (X) system of the example of comparison. In addition, both experiments used MH bomb filled up with about 400l. hydrogen.

[0015] Consequently, it was 100 minutes in the (X) system of the example of comparison to operation time being 110 minutes in the (A) system of this invention. Therefore, it is admitted that operation time has extended the (A) system of this invention clearly compared with the (X) system of the example of comparison. By the (A) system of this invention, to the ability to raise the utilization factor of pure hydrogen even to 100% of abbreviation by recycling effectively the unreacted hydrogen produced in the case of a cell reaction, since this has discharged about 10% of unreacted hydrogen out of a system, it originates in the utilization factor of pure hydrogen being as low as about 90% in the (X) system of the example of comparison.

[0016] (The second example) Instead of using a blower 6, drawing 2 uses an injector 7, forms a check valve 8 in the unreacted hydrogen recycling pipe 5, and also is the outline block diagram of the fuel cell system concerning the second example of this invention, and is the same composition as the first example of the above, and abbreviation. In addition, the number same about the component which has the same function as the first example of the above as the first example is attached, and explanation is omitted.

[0017] First, if air (oxygen) is supplied to cathode 1a of the fuel cell main part 1 while opening a regulator 4 and supplying pure hydrogen to anode 1b of the fuel cell main part 1 through the hydrogen charging line 3 from the inside of the MH bomb 2, a cell reaction will be started soon. After a while, advance of a cell reaction produces the unreacted pure hydrogen (usually about 5 - 10%) which did not contribute to a cell reaction from the fuel cell main part 1. After this unreacted pure hydrogen flows the unreacted hydrogen recycling pipe 5 to the pure hydrogen charging-line 3 side, it is pressurized by about 100-200 mmAqs with an injector 7. And it is recycled through a regulator 4 at the anode 1b side, and is again used for a cell reaction. In this case, the pressures of the pure hydrogen supplied from the MH bomb 2 are 4 kg/cm2. It is a grade and is controlled by the downstream of a regulator 4 to be set to 100 - 200mmAq. Thus, according to this invention, the unreacted hydrogen which was not used at all can be effectively used only by discharging out of a system conventionally.

[0018] In addition, although the water other than unreacted hydrogen is contained from the fuel cell main part 1 in the case of a cell reaction, since this water can carry out evaporation removal by forming a heat exchanger etc. in the middle of the unreacted hydrogen recycling pipe 5, only the pure hydrogen which did not contribute to a cell reaction is recyclable.

[Other matters] It sets in the above-mentioned example and is MmNi4.32Mn0.18aluminum0.1 Fe0.1 Co0.3 of a rare earth system as a hydrogen storing metal alloy. Although used, of course, it is also possible for this invention not to be limited to this at all, and to use hydrogen storing metal alloys, such as a Ti-Mn system, a Ti-Fe system, a Ti-Zr system, a Mg-nickel system, and a

Zr-Mn system.

[0019]

[Effect of the Invention] Since the unreacted pure hydrogen (usually about 5 - 10%) which did not contribute to a cell reaction is recyclable on a fuel cell main part according to the above this invention, the pure hydrogen supplied from a pure hydrogen supply means can be used for 100% electrode reaction of abbreviation. In this case, if a pure hydrogen supply means is MH bomb etc., since the generating duration of a bomb will extend about 5 to 10%, the troublesome work of bomb exchange etc. can be reduced.

[0020] Moreover, since there is almost no unreacted hydrogen which can use pure hydrogen for 100% cell reaction of abbreviation, and is discharged out of a system, a catalyzed-combustion machine etc. becomes unnecessary. Therefore, enlargement of a system can be suppressed and reduction of cost can also be aimed at.

[Brief Description of the Drawings]

[Drawing 1] It is the outline block diagram of the fuel cell system concerning the first example of this invention.

[Drawing 2] It is the outline block diagram of the fuel cell system concerning the second example of this invention.

[Drawing 3] It is the outline block diagram of the conventional fuel cell system.

[Description of Notations]

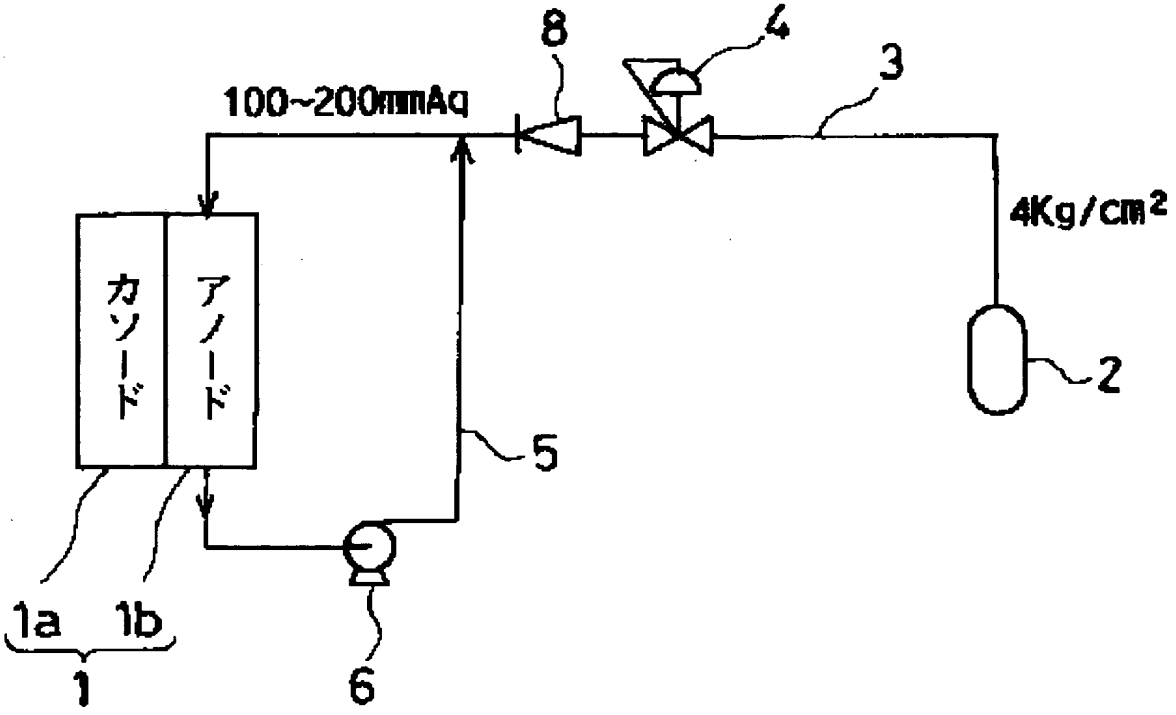
1 Fuel Cell Main Part

2 MH Bomb

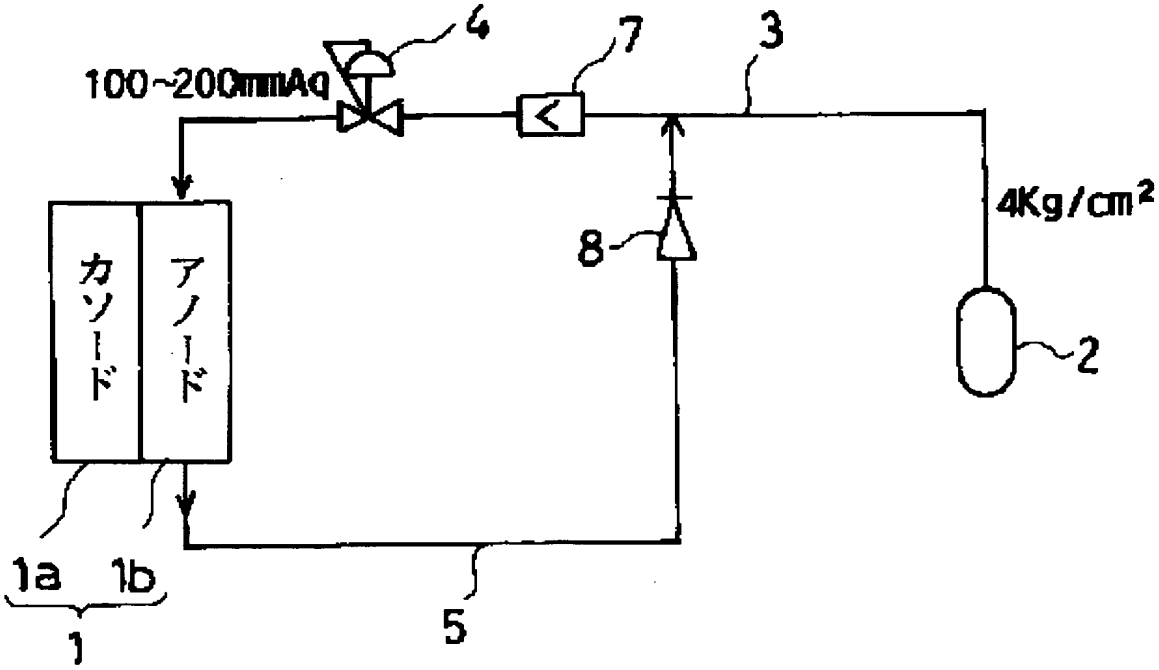
5 Unreacted Hydrogen Recycling Pipe

6 Blower

[Drawing 1]



[Drawing 2]



[Drawing 3]